

Amendment Under 37 C.F.R. §1.114
Application No. 10/809,809
Attorney Docket No. 042278

REMARKS

Claims 1-9, 11-14, 16, 17, 19 and 21-24 are pending in the application. Claims 9 and 14 are herein amended. Claim 10 is herein cancelled. Claims 1-8, 12, 13, 16, 17, 19 and 21-24 are withdrawn from consideration.

Claim Rejections - 35 U.S.C. §§ 102 and 103

A. Rejection based on Shimamoto

Claims 9-11 and 14 were rejected under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over **Shimamoto** (US 2004/0188762). Favorable reconsideration is requested.

Applicants note that Shimamoto is not prior art under § 102(b). Shimamoto published on September 30, 2004 which is after the filing date of the present application (March 26, 2004). Shimamoto is prior art under § 102(e) since it was filed (March 1, 2004) before the filing of the present application.

Claim 9 has been amended to recite that introducing nitrogen and displacing silicon atoms are conducted by a heat treatment in an ammonia atmosphere.

Applicants respectfully submit Shimamoto does not teach or suggest:

introducing nitrogen into said silicon oxide film and displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side by conducting a heat treatment to said silicon oxide film in an ammonia atmosphere

as recited in amended claim 9.

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Shimamoto discloses annealing in an NO or NO₂ atmosphere. Shimamoto does not disclose annealing in an ammonia atmosphere.

A heat treatment in an ammonia atmosphere is more effective than a heat treatment in an NO or NO₂ atmosphere as demonstrated in the experimental results shown in Fig. 16 of the present invention.

Therefore, Shimamoto does not teach or suggest the elements as recited in claim 9.

B. Rejection Based on Roy in view of Wang

Claims 9-11 and 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Roy (US 2003/0186499) in view of Wang (US 2003/0181012). Favorable reconsideration is requested.

Applicants respectfully submit that Roy in view of Wang does not teach or suggest:

introducing nitrogen into said silicon oxide film and displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side by conducting a heat treatment to said silicon oxide film in an ammonia atmosphere

as recited in amended claim 9.

In Roy, a plasma nitridation on the upper surface of the oxide layer 14 is given as an example of a method for forming the transition layer 28; however, there is no description relating to annealing in an ammonia atmosphere. If the plasma nitridation is conducted on the upper surface of the oxide layer 14, the Si atoms are displaced toward an unfavorable direction.

In Wang, silicon atoms are never displaced because nitriding is conducted to a thick oxide film. As previously pointed out by citation to Awaji, *High-Precision X-Ray Reflectivity Study of*

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Ultrathin SiO₂ on Si, J. Vac. Sci. Technology A., vol. 14, no. 3, pp. 971-976, May 1996 (“Awaji”), strain cannot be generated to a thick oxide film by introducing nitrogen. (See Amendment, March 9, 2006, pages 9-10.) Therefore, Roy in view Wang does not teach or suggest the elements as recited in claim 9.

Applicants also respectfully submit that one of ordinary skill in the art would not have been motivated to combine Roy and Wang.

Roy discloses that the favorable temperature for forming the transition layer 28 is no greater than 100°C. (Paragraph 26.) Roy also discloses a preference for avoiding high temperature processing operations for the formation of semiconductor devices to prevent diffusion of boron from polycrystalline silicon into the gate dielectric material. (Paragraph 5.) Wang discloses nitriding the oxide films at 900 °C and annealing at 1050 °C. Thus, Roy teaches away from using the method disclosed in Wang.

For at least the foregoing reasons, claim 9 is patentable over the cited references, and claims 11 and 14 are patentable by virtue of their dependence from claim 9. Accordingly, withdrawal of the rejections of claims 9, 11 and 14 is hereby solicited.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

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If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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